GDQ75S12B-4Q DC-DC Converter

Technical Manual

Issue 1.0

Date 2020-12-25

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About This Document

Purpose

This document describes the GDQ75S12B-4Q DC-DC converter, including its electrical specifications, features, applications, and communication.

The figures provided in this document are for reference only.

Intended Audience

This document is intended for:

- Sales personnel
- Technical support engineers
- System engineers
- Software engineers
- Hardware engineers

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

Change History

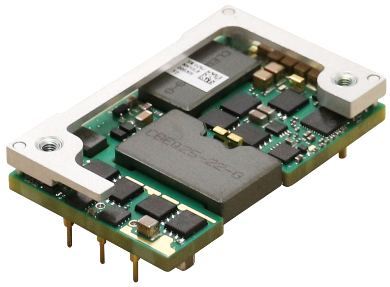
Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

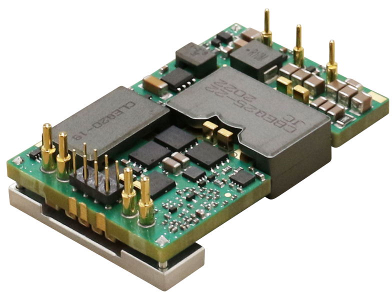
Issue 1.0 (2020-12-25)

This issue is the first release.

Contents

1 Product Overview





Product Description

The GDQ75S12B-4Q is a new generation isolated DC-DC converter that uses an industry standard quarter-brick structure, featuring high efficiency and power density with low output ripple and noise. It operates from an input voltage range of 36 V to 75 V, and provides the rated output voltage of 12 V as well as the maximum output current of 75 A.

Features

- Efficiency: 96.5% (T_A = 25°C; V_{in} = 48 V, 50% load; V_{in} = 36 V, 50% load)
- Length x Width x Height: 57.9 mm x 36.8 mm x 13.4 mm (2.280 in. x 1.450 in. x 0.528 in.)
- Weight: 85 g
- Input undervoltage protection
- Auxilary undervoltage protection
- Output overcurrent protection (hiccup mode)
- Output short circuit protection (hiccup mode)
- Output overvoltage protection (hiccup mode)
- Overtemperature protection (self-recovery)
- Remote on/off, PMBus communication
- UL certification
- UL 60950-1, UL 62368-1, C22.2 No. 60950-1 compliant
- RoHS6 compliant

Model Naming Convention

GDQ	75	S	12	B	-	4	Q
1	2	3	4	5		6	7

1 — 48 V input, high performance, digital control, standard quarter-brick

2 — Output current: 75 A

3 — Single output

4 — Output voltage: 12 V

5 — With a baseplate

6 — Pin length: 4.8 mm

7 — PMBus

Applications

Widely used in telecom, industrial, instrument monitoring, and test equipment applications

2 Electrical Specifications

2.1 Absolute maximum ratings

Table 2-1 Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Input voltage ● Continuous ● Transient (100 ms)	 - -	 - -	 80 100	 V V	When the input voltage is in the range of 75 V to 80 V, the converter must not be damaged.
Operating temperature (T_A)	–40	-	85	°C	-
Storage temperature	–55	-	125	°C	-
Relative humidity	10	-	95	% RH	Non-condensing
External voltage applied to ON/OFF	-	-	12	V	-
External voltage applied to PMBus	-	-	3.6	V	-
Altitude	-	-	5000	m	-

2.2 Input

Table 2-2 Input specification

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Operating input voltage	36	48	75	V	-
Maximum input current	-	-	35	A	V_{in} = 0–75 V, I_{out} = I_{onom}
No-load loss	-	8	11	W	V_{in} = 48 V, I_{out} = 0 A, T_A = 25°C

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Input capacitance	440	680	-	µF	Aluminum electrolytic capacitor
Response to input transient	-	1.5	2.0	V	0.5 V/µs input transient, V_{in} = 43–75 V, 100% load
	-	-	3	V	0.5 V/µs input transient, V_{in} = 36–75 V, 100% load

2.3 Output

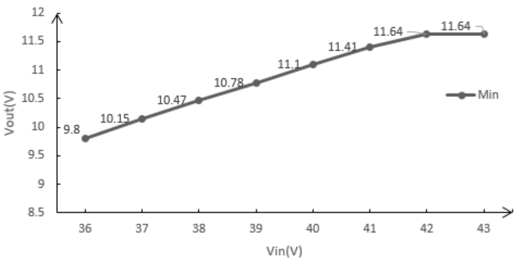
Table 2-3 Output specification

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Output voltage setpoint	11.88	12.00	12.12	V	T_A = 25°C, V_{in} = 48 V, I_{out} = 50% I_{onom}
Output voltage	11.64	-	12.36	V	V_{in} = 43–75 V, I_{out} = I_{onom}
	9.80	-	12.36	V	V_{in} = 36–43 V, I_{out} = I_{onom} (see **Note**)
Output current	0	-	75	A	-
Output power	0	-	900	W	-
Line regulation	–0.5	-	0.5	% V_{out}	V_{in} = 43–75 V; I_{out} = I_{onom}
	–17		17	% V_{out}	V_{in} = 36–43 V; I_{out} = I_{onom}
Load regulation	–3	-	3	% V_{out}	V_{in} = 48 V; I_{out} = I_{omin} – I_{onom}
Output voltage regulation precision	–5	-	5	%	V_{in} = 43–75 V; I_{out} = I_{omin} – I_{onom}
	–18	-	18	%	V_{in} = 36–43 V; I_{out} = I_{omin} – I_{onom}
Output temperature coefficient	–0.02	-	0.02	%/°C	T_A = –40°C to +85°C
Output external capacitance	660	-	6000	µF	SMD aluminum solid capacitor or chip aluminum capacitor, ESR < 30 mΩ. During the equipment test, the layout distance of minimum capacitor must be extended to less than 5 cm.

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Ripple and noise (peak to peak)	-	180	500	mV	Oscilloscope bandwidth: 20 MHz.
Output voltage adjustment	8.4	-	12.2	V	V_{in} = 43–75 V, adjusted by PMBus, V_{out} can be adjusted online from 11.1 V to 12.2 V. If V_{out} set by the command is beyond this range, the module will restart immediately to enable the parameter to take effect. see **8 Communication**.
	8.4	-	0.315 Vin −1.5	V	V_{in} = 36–43 V, adjusted by PMBus, V_{out} can be adjusted online from 11.1 V to 12.2 V. If V_{out} set by the command is beyond this range, the module will restart immediately to enable the parameter to take effect. see **8 Communication**.
Output voltage overshoot	-	-	5	%	Full range of V_{in}, I_{out}, and T_A
Output voltage delay time	-	50	100	ms	From V_{in} to 10% V_{out}
Output voltage rise time	-	50	100	ms	V_{in} = 43–75 V, from 10% V_{out} to 90% V_{out}, see **4.4 Output Voltage Rise Time**.
Switching frequency	-	180	-	kHz	-

NOTE

- The relation curve of the V_{in} = 36–43 V and V_{out} (steady state).



2.4 Efficiency

Table 2-4 Efficiency specification

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
100% load	93.5	95.5	-	%	T_A = 25°C, V_{in} = 48 V
50% load	94.5.	96.5	-	%	
20% load	93	95	-	%	
100% load	93	95	-	%	T_A = 25°C, V_{in} = 36 V
50% load	94.5	96.5	-	%	
100% load	92.5	94.5	-	%	T_A = 25°C, V_{in} = 75 V
50% load	93	95	-	%	

2.5 Protection

Table 2-5 Input Protection

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Input undervoltage protection startup threshold	32	34	36	V	-
Input undervoltage protection shutdown threshold	30	32	34	V	-
Input undervoltage protection hysteresis	1	2	3	V	-
Auxiliary input undervoltage protection startup threshold	25.5	28.0	31.5	V	-
Auxiliary input undervoltage protection shutdown threshold	22.5	26.0	29.5	V	-
Auxiliary input undervoltage protection hysteresis	0.7	1.9	3.0	V	-

Table 2-6 Output Protection

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Output overcurrent protection	110	-	140	% I_{omax}	Hiccup mode
Output short circuit protection	-	-	-	-	Hiccup mode, and system reports OVP protection Short circuit impedance is not less than 100 milliohms.
Output overvoltage protection	13.2	-	16	V	Hiccup mode, and system reports OVP protection
Overtemperature protection threshold	105	120	130	°C	Self-recovery; The overtemperature protection hysteresis is obtained by measuring the temperature of the PCB near the temperature sensor.
Overtemperature protection hysteresis	5	-	-	°C	

2.6 Dynamic Characteristics

Table 2-7 Dynamic characteristics

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Overshoot amplitude	-	-	600	mV	V_{in} = 43–75 V, current change rate: 0.1 A/μs, T = 5 ms, load: 25%–50%–25%; 50%–75%–50%
Overshoot recovery time	-	-	200	μs	
Overshoot amplitude	-	-	1200	mV	V_{in} = 43–75 V, current change rate: 1 A/μs, T = 5 ms, load: 25%–50%–25%; 50%–75%–50% (additional 1000 μF load capacitor)
Overshoot recovery time	-	-	500	μs	

NOTE

Larger than 80% load step, there is no special standard.

2.7 Insulation Characteristics

Table 2-8 Insulation characteristics

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Input to output insulation voltage	-	-	1500	V	Basic insulation (1-minute test), leakage current < 1 mA, altitude = 3000 m
Input to baseplate insulation voltage	-	-	750	V	
Output to baseplate insulation voltage	-	-	750	V	
Input to output insulation voltage	-	-	1500	V	Functional insulation (1-minute test), leakage current < 1 mA, altitude = 5000 m
Input to baseplate insulation voltage	-	-	750	V	
Output to baseplate insulation voltage	-	-	750	V	

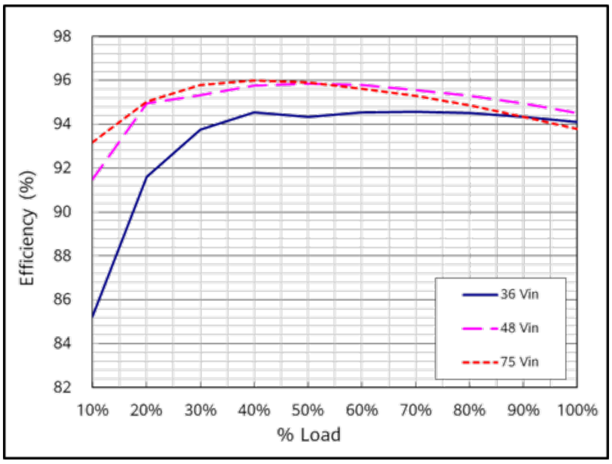
2.8 Other Characteristics

Table 2-9 Other characteristics

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Remote On/Off voltage low level	–0.7	-	1.2	V	Negative logic
Remote On/Off voltage high level	3.5	-	12	V	
On/Off current low level	-	-	1	mA	-
On/Off current high level	-	-	-	μA	
PMBus_CTL voltage low level	0	-	0.8	V	High level effective High level is enable; low level is disable
PMBus_CTL voltage high level	2.1	-	3.3	V	
PMBus_CTL current low level	-	-	1	mA	-

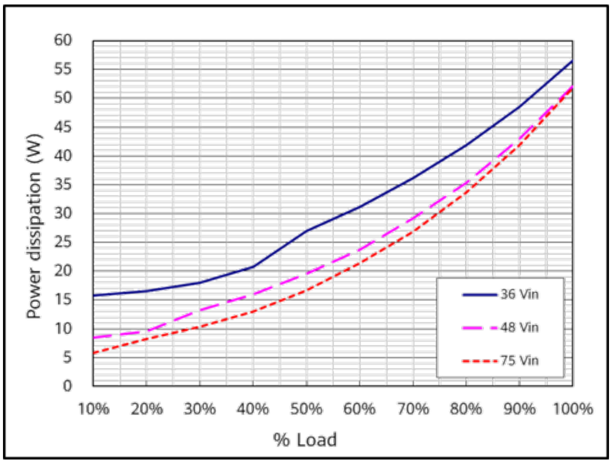
Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Mean time between failures (MTBF)	-	2.5	-	Million hours	Telcordia, SR332 Method 1 Case 3; 80% load, normal input/rated output; 300 LFM; T_A = 40°C.

3 Characteristic Curves



Efficiency curve

(T_A = 25°C; V_{in} = 36 V, 48 V, or 75 V)



Power dissipation curve

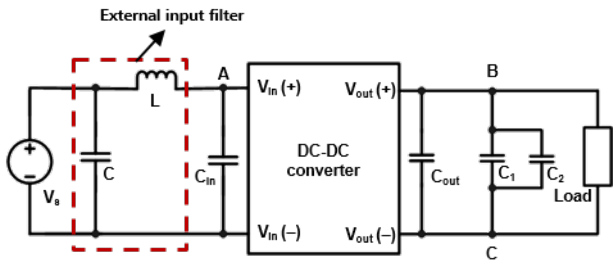
(T_A = 25°C; V_{in} = 36 V, 48 V, or 75 V)

4 Typical Waveforms

NOTE

- During the test of input reflected ripple current, the input must be connected to an external input filter (including a 12 μH inductor and a 220 μF electrolytic capacitor), which is not required in other tests.
- Points B and C are for testing the output voltage ripple.

Figure 4-1 Test set-up diagram



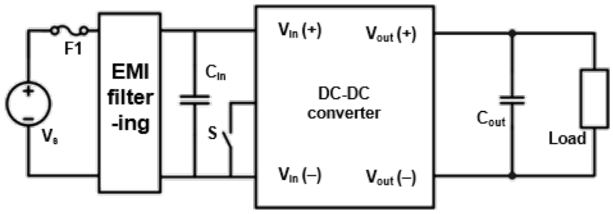
C_{in}: The 440 μF aluminum electrolytic capacitor is recommended.

C_{out}: The 660 μF SMD aluminum solid capacitor or chip aluminum capacitor is recommended (ESR < 30 mΩ).

C_1: The 0.1 μF ceramic capacitor is recommended.

C_2: The 10 μF aluminum electrolytic capacitor is recommended.

Figure 4-2 Typical circuit applications

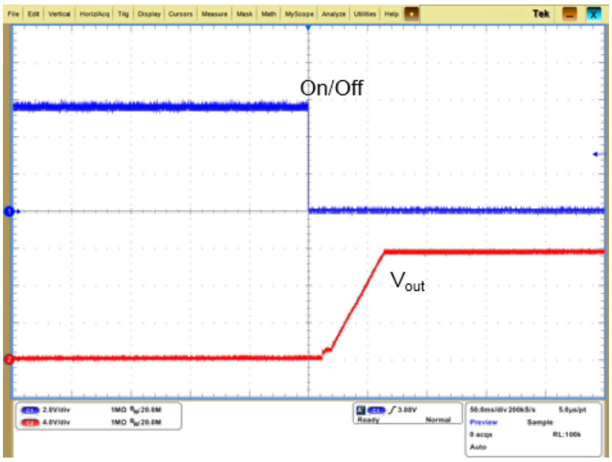


F_1: The 50 A fuse (fast-blow).

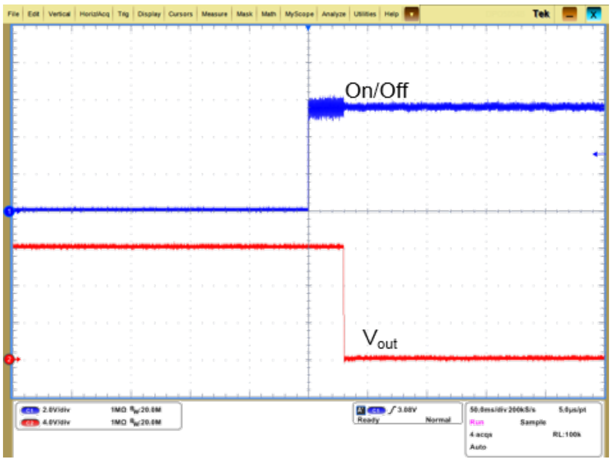
C_{in}: The 440 μF aluminum electrolytic capacitor is recommended.

C_{out}: The 660 μF SMD aluminum solid capacitor or chip aluminum capacitor is recommended (ESR < 30 mΩ).

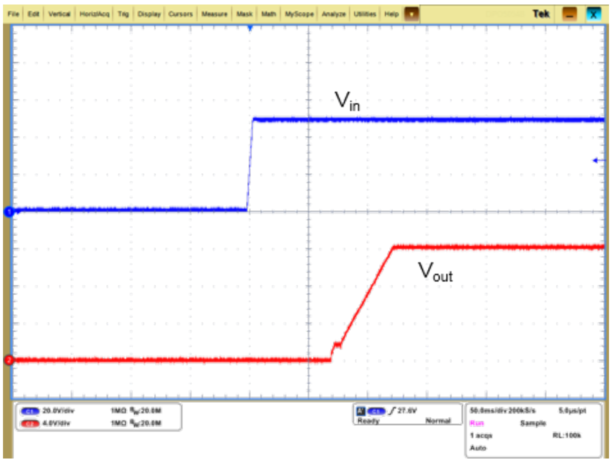
4.1 Turn-on/Turn-off



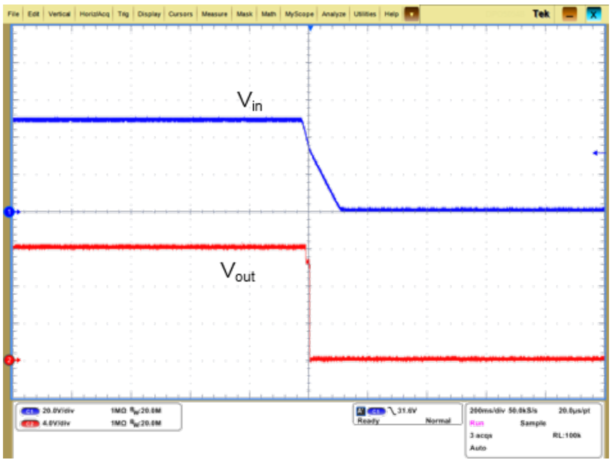
Startup from On/Off



Shutdown from On/Off

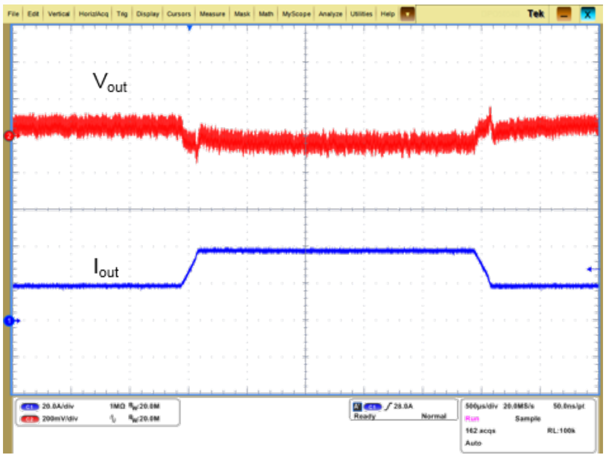


Startup by power-on

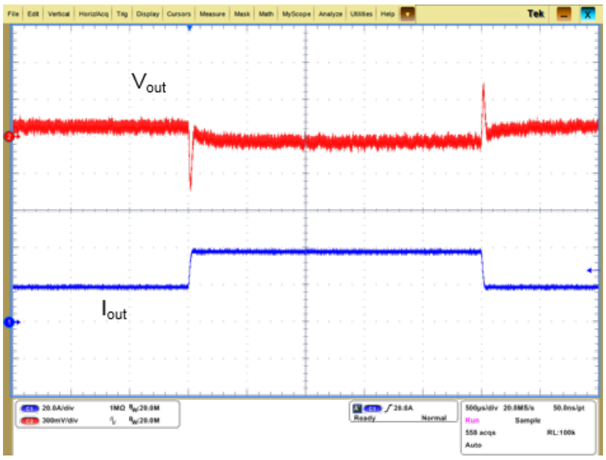


Shutdown by power-off

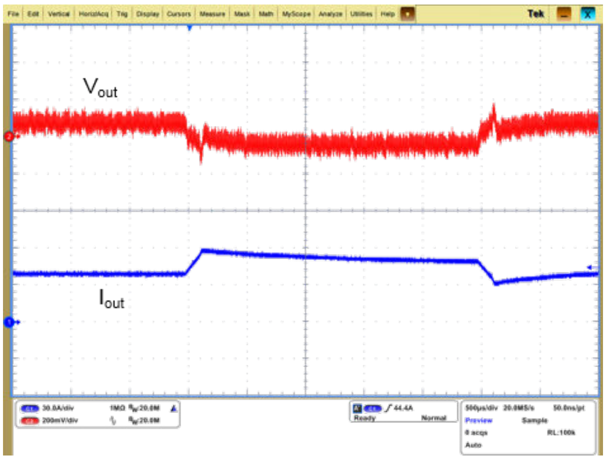
4.2 Output Voltage Dynamic Response



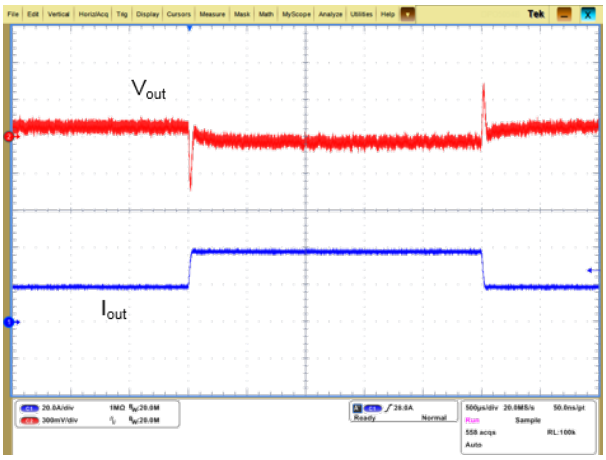
Output voltage dynamic response
(load: 25%–50%–25%, di/dt = 0.1 A/μs)



Output voltage dynamic response
(load: 25%–50%–25%, di/dt = 1 A/μs)

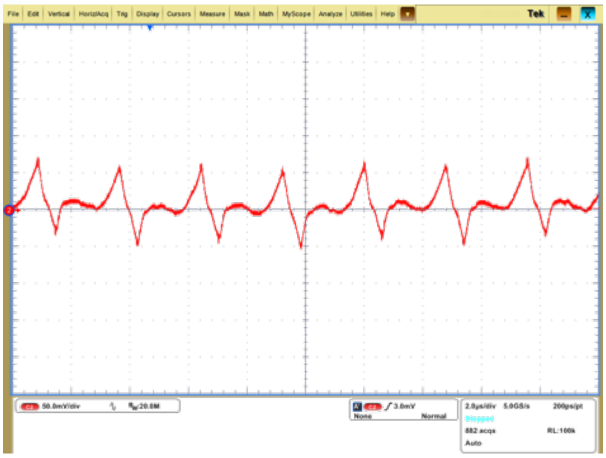


Output voltage dynamic response
(load: 50%–75%–50%, di/dt = 0.1 A/μs)



Output voltage dynamic response
(load: 50%–75%–50%, di/dt = 1 A/μs)

4.3 Output Voltage Ripple

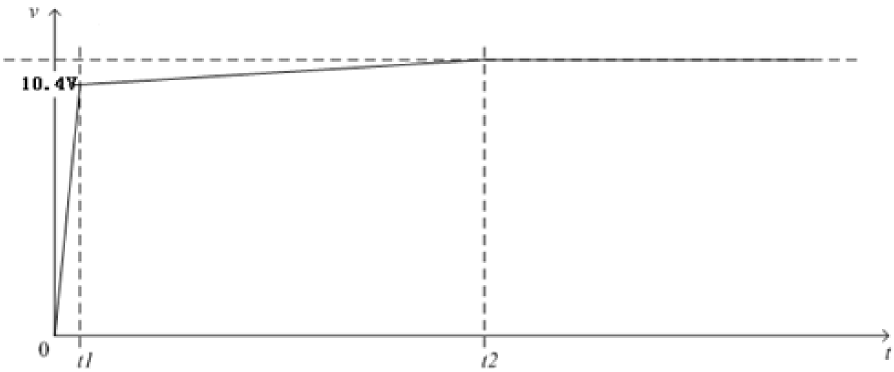


Output voltage ripple
(for points B and C in the test set-up diagram, V_{in} = 48 V, V_{out} = 12 V, I_{out} = 75 A)

4.4 Output Voltage Rise Time

When the rising slope of V_{in} is below 0.3 V/ms, V_{out} rises to 10.4 V within 100 ms and then rises to terminal value at the rate of 0.033 V/s.

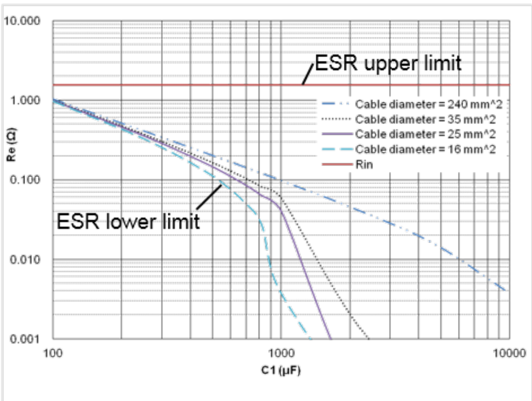
The most time of [0, t1] is 100 ms, and most time of [t1, t2] is 50s.



5 Input Anti-resonance Method

In the input remote power supply application, the parasitic inductor of the remote power supply cable and the input capacitor as well as the power brick may resonate, causing the power input voltage to be unstable. As a result, the PSU may experience a power outage due to undervoltage. Therefore, it is recommended that input capacitors be selected according to the input capacitor ESR conditions as shown in following figure.

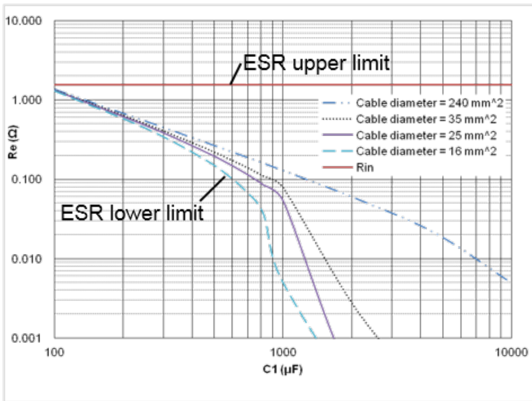
Select the appropriate curve based on the application scenario, and ensure that the input capacitor ESR is within the upper and lower limits in the curve. Then there will be no input resonance.



Input capacitors with different cross-sectional areas and ESR configuration boundary

Cable length = 60 m, V_{in} = 36 V, I_{out} = 75 A,

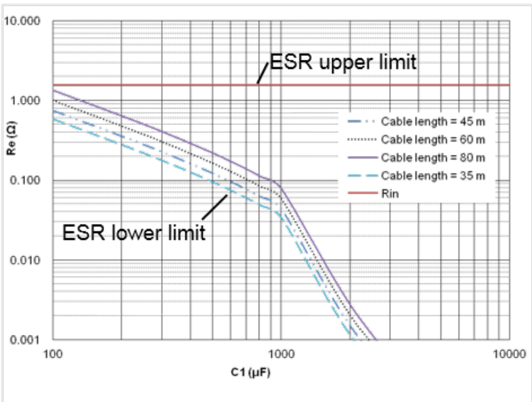
T_A = –40°C

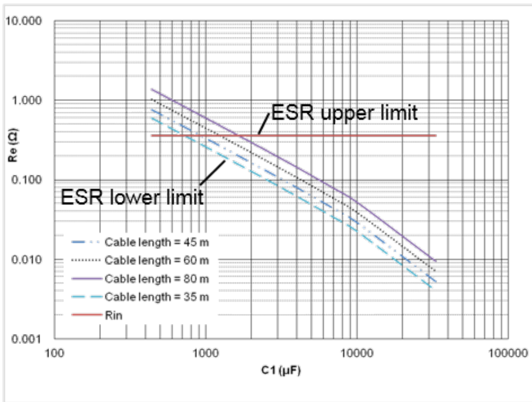


Input capacitors with different cross-sectional areas and ESR configuration boundary

Cable length = 80 m, V_{in} = 36 V, I_{out} = 75 A,

T_A = –40°C





Input capacitors and ESR configuration boundary

Cable diameter = 35 mm^2, V_{in} = 36 V,

I_{out} = 75 A, T_A = –40°C

Input capacitors and ESR configuration boundary (parallel mode)

Cable diameter = 240 mm^2, V_{in} = 36 V,

I_{out} = 300 A, T_A = –40°C

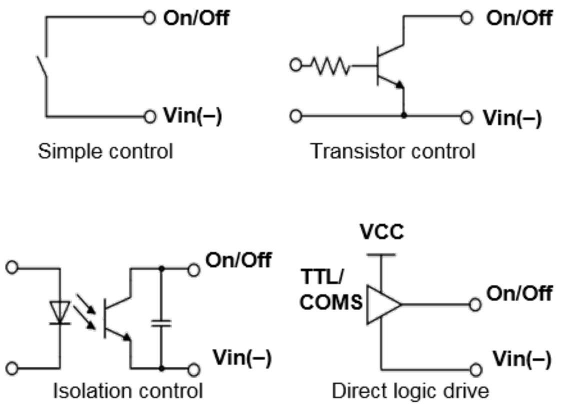
6 Remote On/Off

The main output of module can be turned on or turned off by On/Off signal.

On/Off Pin Level	Status
Low level [–0.7 V, 1.2 V]	On
High level [3.5 V, 12.0 V]	Off

On/Off Signal	Max.
On/Off current (low level)	1 mA

Figure 6-1 Various circuits for driving the On/Off pin



7 Protection Characteristics

- **Input Undervoltage Protection**

  The converter will shut down after the input voltage drops below the undervoltage protection threshold. The converter will start to work again after the input voltage reaches the input undervoltage recovery threshold. For the hysteresis, see **Input protection**.

- **Output Overvoltage Protection**

  When the output voltage exceeds the output overvoltage protection threshold, the converter will enter hiccup mode. When the fault condition is removed, the converter will automatically restart.

- **Output Overcurrent Protection**

  The converter equipped with current limiting circuitry can provide protection from an output overload or short circuit condition. If the output current exceeds the output overcurrent protection setpoint, the converter enters hiccup mode. When the fault condition is removed, the converter will automatically restart.

- **Overtemperature Protection**

  A temperature sensor on the converter senses the average temperature of the converter. It protects the converter from being damaged at high temperatures. When the temperature exceeds the overtemperature protection threshold, the output will shut down. It will allow the converter to turn on again when the temperature of the sensed location falls by the value of the overtemperature protection hysteresis.

8 Communication

8.1 Signal Specifications

Table 8-1 PMBus signal interface characteristics

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Logic input low (V_{IL})	-	-	0.8	V	-
Logic input high (V_{IH})	2.1	-	3.6	V	-
Logic output low (V_{OL})	-	-	0.4	V	I_{OL} = –10 mA
Logic output high (V_{OH})	2.4	-	3.6	V	I_{OH} = 13 mA
PMbus setting-up time	250	-	-	ns	For details about the values of T_{set} and T_{hold}, see **8.2.3 Data Transmission Mode**.
PMBus holding time	300	-	-	ns	

Table 8-2 PMBus detection precision

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Input voltage detection precision	–2	-	2	V	V_{in} = 36–75 V, I_{out} = I_{omin} – I_{onom}, T_A = –40°C to +85°C
Output voltage detection precision	–0.2	-	0.2	V	
Output current detection precision	–5	-	5	A	
Output power detected precision	–65	-	65	W	

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Temperature detection precision	–5	-	5	°C	V_{in}= 36–75 V, I_{out} = I_{omin} – I_{onom}, T_A = –40°C to +125°C

8.2 Data Link Layer Protocol

The link layer uses the PMBus V1.2 protocol and complies with *PMBus_Specification_Part_I_Rev_1-2_20100906* and *PMBus_Specification_Part_II_Rev_1-2_20100906*.

8.2.1 PMBus Address

The following table describes the mapping between the SA0, SA1 and PMBus address. When the SA0 and SA1 left open, PMBus address is 0X5B. When the SA0 and SA1 connect to GND, PMbus address is 0, which is prohibition of use. The PMBus address can be calculated as D:

D = 12 x SA1 + SA0

D is the corresponding decimal number of PMBus address data.

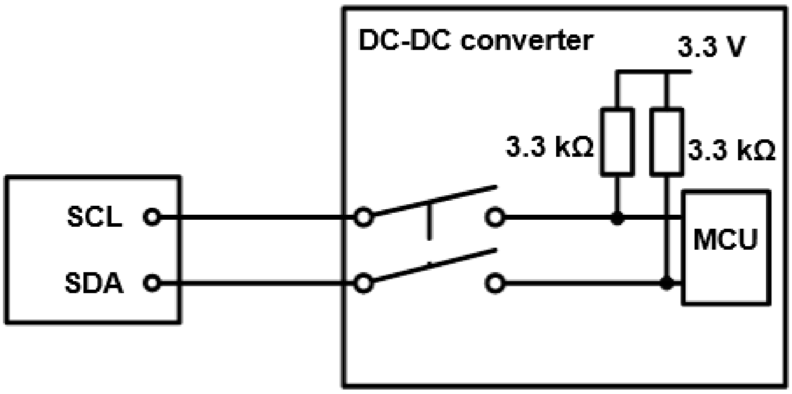
R_{SA1} (kΩ)	SA1 (V)	SA1 Address (DEC)
0–0.33	0–0.6	0
Left open	2.2–3.3	7

R_{SA0} (kΩ)	SA0 (V)	SA0 Address (DEC)
1–15	0–0.165	0
22	0.198–0.242	1
30	0.270–0.330	2
51	0.459–0.561	3
80.6	0.725–0.887	4
113	1.017–1.243	5
150	1.350–1.650	6
> 220 (Left open)	1.980–2.500	7

8.2.2 SCL and SDA

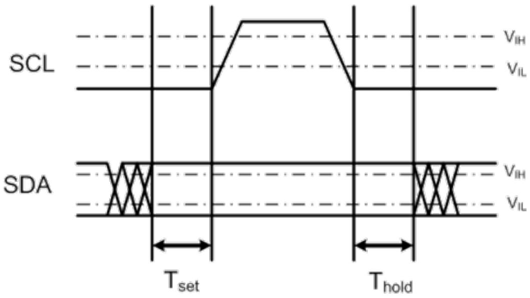
The SCL and SDA are each connected to a pull-up resistor and connected to the communication bus through the fault isolation circuit.

Figure 8-1 Interconnect diagram of SCL and SDA



8.2.3 Data Transmission Mode

The converter supports 400 kHz clock rates. T_{set} is the duration for which SDA keeps its value unchanged before SCL increases. T_{hold} is the duration for which SDA keeps its value unchanged after SCL decreases. Communication will fail if the time is not consistent with the specifications.



8.3 Network Layer Protocol

8.3.1 Slave Addressing Method

The converter serves as the slave device, and the converter address is identified by the hardware and assigned in static mode. The master device accesses slave devices independently based on the slave device addresses determined by the hardware.

8.3.2 Checksum

To ensure data integrity and accuracy during communication, the converter uses the 8-bit CRC checksum mechanism.

The last byte sent for each communication is the CRC checksum for the communication data. For example, the last byte of the data returned by the converter is the checksum.

The CRC checksum is generated using the multinomial: CRC8.

8.3.3 Data Transmission

The converter complies with standard PMBus communication data formats. The data in each PMBus communication data format carries the CRC checksum.

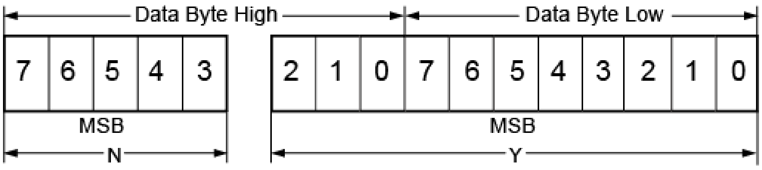
8.4 Application Layer Protocol

8.4.1 Data Format

Linear 11 Data Format

The linear data format is a two-byte value with a 11-bit binary signed mantissa (two's complement) and a 5-bit binary signed exponent (two's complement), as shown in the following figure.

Figure 8-2 Linear 11 data format



The relationship between N, Y, and actual value X is given by the following equation:

$$X = Y \times 2^{N}$$

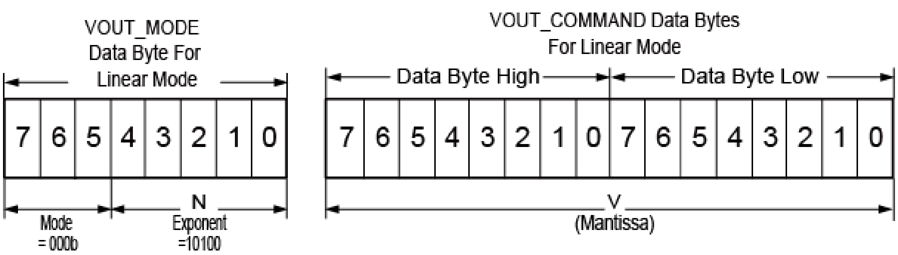
Where:

- Y is the 11-bit, binary signed mantissa (two's complement).
- N is the 5-bit, binary signed exponent (two's complement).

Linear 16 Data Format

The linear data format consists of two parts, with a 16-bit binary unsigned mantissa and a 5-bit binary signed exponent (two's complement), as shown in the following figure.

Figure 8-3 Linear 16 data format



The output voltage is calculated as follows:

$$Voltage = V \times 2^N$$

Where:

- Voltage is the output voltage value.
- V is the 16-bit unsigned integer.
- N is the 5-bit signed integer (two's complement).

8.4.2 Commands

Hex Code	Command Name	Data Type	Data Format
0x00	PAGE	Read/Write Byte	-
0x01	OPERATION	Read/Write Byte	-
0x03	CLEAR_FAULTS	Send Byte	-
0x11	STORE_DEFAULT_ALL	Send Byte	-
0x20	VOUT_MODE	Read Byte	Q10
0x21	VOUT_COMMAND	Read/Write Word	Linear 16
0x40	VOUT_OV_FAULT_LIMIT	Read/Write Word	Linear 16
0x42	VOUT_OV_WARNNING_LIMIT	Read/Write Word	Linear 16
0x46	IOUT_OC_FAULT_LIMIT	Read/Write Word	Linear 11 (Q3)
0x4A	IOUT_OC_WARNNING_LIMIT	Read/Write Word	Linear 11 (Q3)
0x4F	OT_FAULT_LIMIT	Read/Write Word	Linear 11 (Q2)
0x51	OT_WARNNING_LIMIT	Read/Write Word	Linear 11 (Q3)
0x59	VIN_UV_FAULT_LIMIT	Read/Write Word	Linear 11 (Q3)
0x58	VIN_UV_WARNNING_LIMIT	Read/Write Word	Linear 11 (Q3)
0x78	STATUS_BYTE	Read Byte	-
0x79	STATUS_WORD	Read Word	-
0x7A	STATUS_VOUT	Read Byte	-
0x7B	STATUS_IOUT	Read Byte	-
0x7C	STATUS_INPUT	Read Byte	-
0x7D	STATUS_TEMPERATURE	Read Byte	-
0x7E	STATUS_CML	Read Byte	-

Hex Code	Command Name	Data Type	Data Format
0x88	READ_VIN	Read Word	Linear 11 (Q3)
0x8B	READ_VOUT	Read Word	Linear 16 (Q10)
0x8C	READ_IOUT	Read Word	Linear 11 (Q3)
0x8D	READ_TEMPERATURE	Read Word	Linear 11 (Q2)
0x95	READ_FREQUENCY	Read Word	Linear 11 (Q0)
0x96	READ_POUT	Read Word	Linear 11 (Q0)
0x60	TON_DELAY	Read/Write Word	Linear 11 (Q0)
0x61	TON_RISE	Read Word	Linear 11 (Q0)
0xD1	SOFT_VERSION	Read Word	-
0xF6	PCB_VERSION	Read Word	-
0xF3	Soft80Version	Read Word	-
0xF7	Soft40Version	Read Word	-
0x98	PMBUS_VERSION	Read Byte	-
0x80	MFR_STATUS	Read Byte	-
0x99	MFR_ID	Read Block	ASCII
0x9A	MFR_MODEL	Read Block	ASCII
0x9B	MFR_REVISION	Read Block	ASCII
0x9C	MFR_LOCATION	Read Block	ASCII
0x9D	MFR_DATE	Read Block	ASCII
0xD0	PROTOCOL_TYPE	Read Word	-
0xFA	PMBUS_READ_BARCODE_HEADER	Read/Write Block	-
0xFB	PMBUS_BARCODE	Read/Write Block	-
0xF8	SOFTLOAD_INFO	Read Block	ASCII
0xFC	SOFTLOAD_CTRL	Read/Write Word	Unsigned
0xFD	MFR_DEVICE_ID	Write Block	-
0xEA	WRITE_BBOX_FRAME_ID	Read/Write Word	Unsigned
0xEB	READ_BBOX_FRAME_DATA	Read Block	Unsigned
0xEC	BBOX_SYS_TIME	Read/Write Block	Unsigned

Hex Code	Command Name	Data Type	Data Format
0xEE	BBOX_FRAME_LEN	Read/Write Word	-
0xEF	READ_BBOX_FRAME_NUM	Read Word	Unsigned

8.4.3 Command Descriptions

STATUS_WORD (0x79)

Parameter	Bit No.	Command Name
High-order bits	15	VOUT
	14	IOUT/POUT
	13	INPUT
	12	MFR
	11	POWER_GOOD
	10	FANS (reserved)
	9	OTHER (reserved)
	8	UNKNOWN
Low-order bits	7	BUSY (reserved)
	6	OFF
	5	VOUT_OV
	4	IOUT_OC
	3	VIN_UV
	2	TEMPERATURE
	1	CML
	0	NONE OF THE ABOVE

STATUS_VOUT (0x7A)

Bit No.	Command Name
7	OV_FAULT

Bit No.	Command Name
6	OV_WARN
5	UV_WARN (reserved)
4	UV_FAULT (reserved)
3	VOUT_MAX_WARN (reserved)
2	TON_MAX_FAULT (reserved)
1	TOFF_MAX_WARN (reserved)
0	VOUT Tracking Error (reserved)

STATUS_IOUT (0x7B)

Bit No.	Command Name
7	OC_FAULT
6	OC_LV_FAULT (reserved)
5	OC_WARN
4	UC_FAULT (reserved)
3	Current Share Fault (reserved)
2	In Power Limiting Mode (reserved)
1	OP_FAULT (reserved)
0	OP_WARNING (reserved)

STATUS_ INPUT (0x7C)

Bit No.	Command Name
7	OV_FAULT (reserved)
6	OV_WARN
5	UV_WARN
4	UV_FAULT
3	Unit Off For Low Input Voltage (reserved)
2	OC_FAULT (reserved)

Bit No.	Command Name
1	OC_WARN (reserved)
0	OP_WARN (reserved)

STATUS_TEMPERATURE (0x7D)

Bit No.	Command Name
7	OT_FAULT
6	OT_WARNING
5	UT_WARNING (reserved)
4	UT_FAULT (reserved)
3	Reserved (reserved)
2	Reserved (reserved)
1	Reserved (reserved)
0	Reserved (reserved)

STATUS_CML (0x7E)

Bit No.	Command Name
7	INVALID_CMD
6	INVALID_DATA
5	PEC_FAILED
4	MEMORY_FAULT
3	PROC_FAULT
2	Reserved (reserved)
1	COMM_OTHER_FAULT
0	OTHER_FAULT

9 Mechanical Overview

Figure 9-1 Mechanical overview

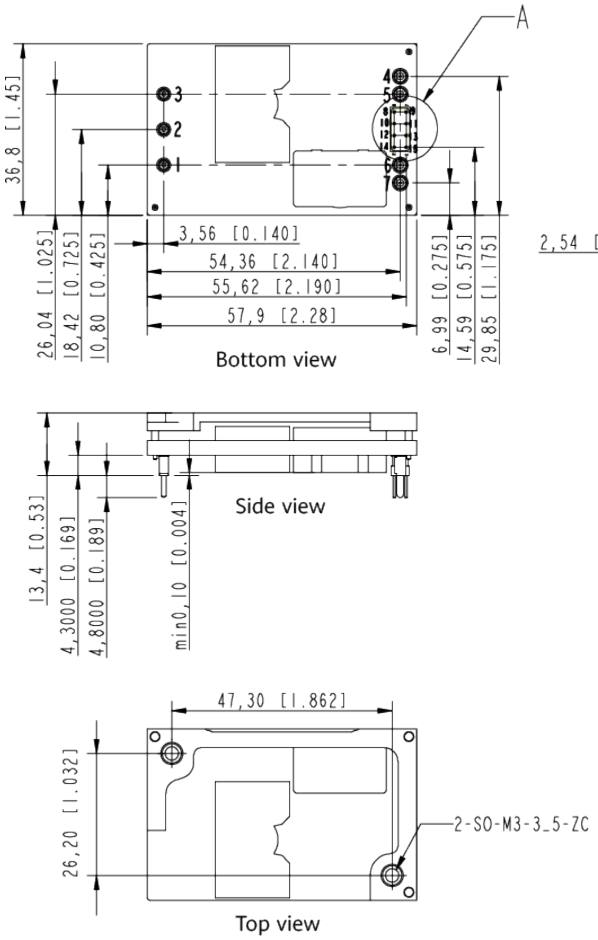


Table 9-1 Pin description

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	V_{in} (+)	6	V_{out} (+)	11	SA1
2	On/Off	7	V_{out} (+)	12	PMBus_CTL
3	V_{in} (–)	8	GND	13	NC
4	V_{out} (–)	9	SA0	14	PMBus_SCL

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
5	V_{out} (–)	10	SYNC	15	PMBus_SDA

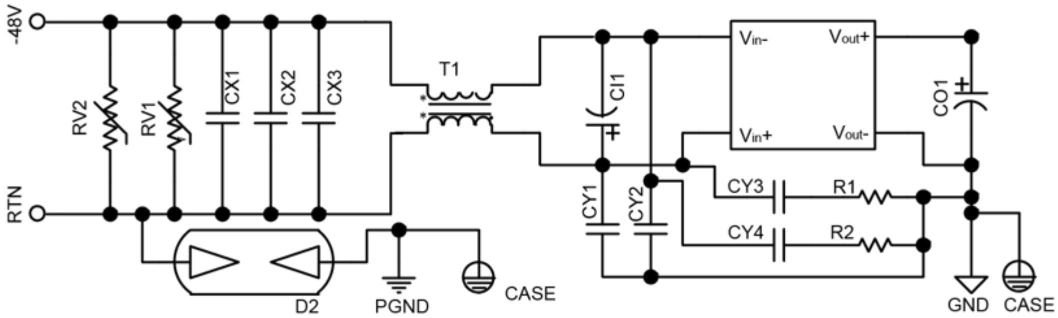
NOTE

1. All dimensions in mm [in.].
   Tolerances: x.x ± 0.5 mm [x.xx ± 0.02 in.]; x.xx ± 0.25 mm [x.xxx ± 0.010 in.].
2. Pins 1–3 are 1.00 ± 0.05 mm [0.040 ± 0.002 in.] diameter with 2.00 ± 0.10 mm [0.080 ± 0.004 in.] diameter standoff shoulders. Pins 4–7 are 1.50 ± 0.05 mm [0.060 ± 0.002 in.] diameter with 2.50 ± 0.10 mm [0.098 ± 0.004 in.] diameter standoff shoulders. Pins 8–15 are 0.50 ± 0.05 mm [0.020 ± 0.002 in.] diameter standoff shoulders.
3. M3 screw used to bolt unit is baseplate to other surfaces (such as heats ink) must not exceed 4.0 mm [0.157 in] depth blow the surface of baseplate.
4. Components will vary between models.

10 Safety

10.1 EMC Specifications

Figure 10-1 EMC test set-up diagram



RV1, RV2: Varistor, 100 V, 4500 A

D2: Gas discharge tube, 90 V, 10 kA

CI1: Aluminum electrolytic capacitor, 100 V, 420 µF and ceramic capacitor, 7 x 4.7 µF, 100 V

CO1: Non-solid radial lead aluminum electrolytic capacitor, 2 x 470 µF

CX1, CX2, CX3: Metalized film capacitor, 1 µF, 275 V

CY1, CY2: Metalized film capacitor, 0.1 µF, 275 V

CY3, CY4: Chip multilayer ceramic capacitor, 22 nF, 1000 V

R1, R2: Chip thick film resistor, 1 W, 1 Ω

T1: Common mode inductor, single phase, 400 µH

Table 10-1 EMC specifications

Parameter	Conditions	Criterion
Conducted emission (CE)	DC Input	EN 55032, class A (6 dB)
Surges	DM 1 kV/CM 2 kV	IEC/EN 61000-4-5, criterion B
DC voltage dips, short interruption, variation	40%/70%/0%	EN 61000-4-29, criterion B
	80%/120%	EN 61000-4-29, criterion A

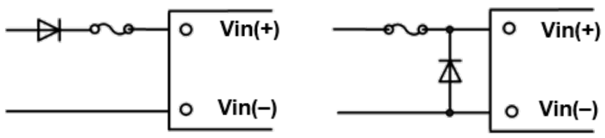
10.2 Recommended Fuse

The converter has no internal fuse. To meet safety requirements, a 50 A fuse is recommended.

10.3 Recommended Reverse Polarity Protection Circuit

Reverse polarity protection is recommended under installation and cabling conditions where reverse polarity across the input may occur.

Figure 10-2 Recommended reverse polarity protection circuits



10.4 Qualification Testing

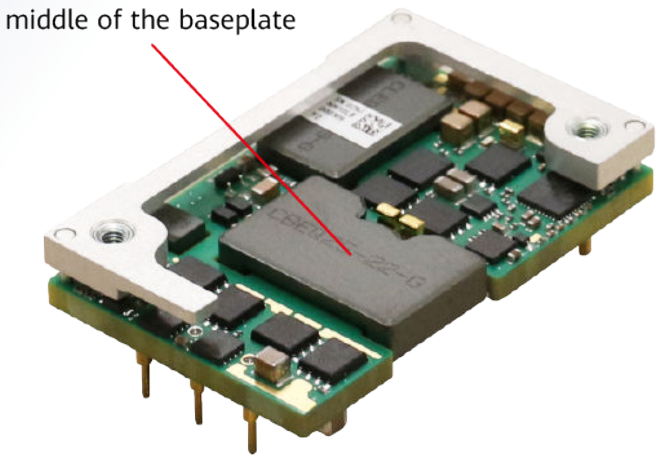
Parameter	Units	Condition
Highly accelerated life test	6	Low temperature limit: –60°C; high temperature limit: 110°C; vibration limit: 40 G; temperature change rate: 40°C per minute; vibration frequency range: 10–10000 Hz; axes of vibration: X/Y/Z
Thermal humidity bias	32	Maximum input voltage; 85°C; 85% RH; 1000 operating hours under lowest load power
High temperature operation bias	32	Rated input voltage; operating temperature between +45°C and +55°C; airflow rate = 0.5–5 m/s, 1000 operating hours; 50% to 80% full load
Power and temperature cycling test	32	Rated input voltage; ambient temperature between –40°C and +85°C; airflow rate = 0.5–5 m/s, 1000 cycles; 50% full load

10.5 Thermal Consideration

Thermal Test Point

Decide proper airflow to be provided by measuring the temperature at the middle of the baseplate shown in Figure 10-3 to protect the converter against overtemperature. The overtemperature protection threshold is obtained based on this thermal test point.

Figure 10-3 Thermal test point



Power Dissipation

The converter power dissipation is calculated based on efficiency. The following formula reflects the relationship between the consumed power (P_d), efficiency (ŋ), and output power (P_o): $P_d = P_o (1 – ŋ)/ŋ$.

10.6 MSL Rating

Store and transport the converter as required by the moisture sensitivity level (MSL) rating 3 specified in the IPC J-STD-020D/033. The surface of a soldered converter must be clean and dry. Otherwise, the assembly, test, or even reliability of the converters will be negatively affected.

10.7 Mechanical Consideration

Installation

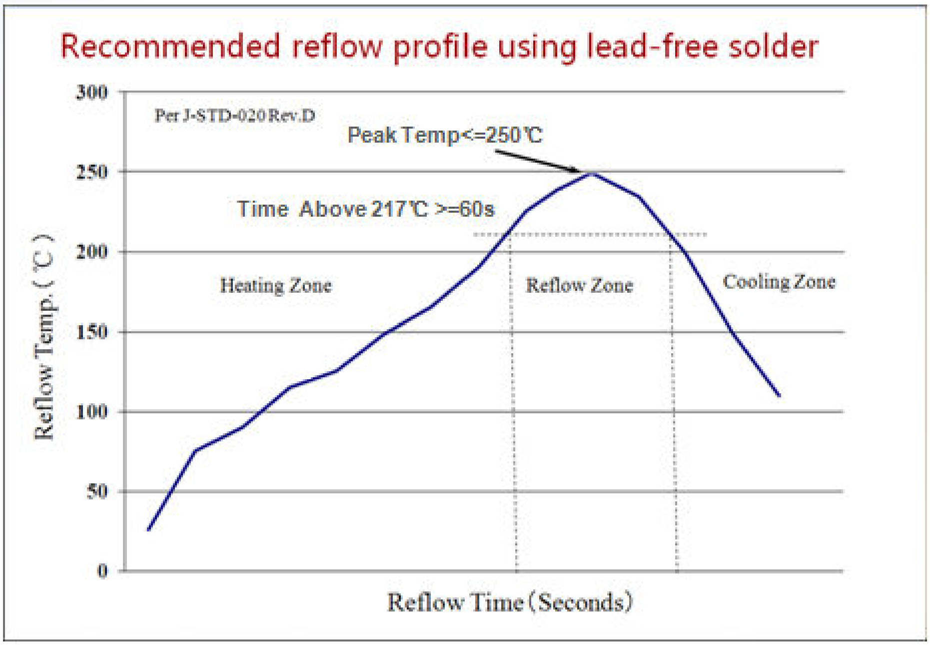
Although the converter can be mounted in any direction, free airflow must be available.

Soldering

1. For reflow soldering, the converter pins can be soldered at 250°C for less than 10 seconds.
2. For hand soldering, the iron temperature should be maintained at 350°C to 420°C and applied to the converter pins for less than 10 seconds.

The converter can be rinsed using the isopropyl alcohol (IPA) solvent or other suitable solvents.

Figure 10-4 Recommended reflow profile using lead-free solder



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